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Hence $\tan \phi = -\tan \psi$, and $\phi + \psi = \pi$; that is, the opposite angles of the maximum quadrilateral are supplementary and hence the quadrilateral is cyclic.

Again, it is shown by elementary geometry, that when three sides of a maximum quadrilateral are given, the fourth side is the diameter of the circumscribing circle of the figure. Hence, to find this diameter AD , let $AD = x$, $AB = a$, $BC = b$, $CD = c$; and let the angles subtended by a , b , c , at the center be 2α , 2β , 2γ .

Then

$$\alpha + \beta + \gamma = \frac{\pi}{2} \quad (1)$$

and

$$\sin(\alpha + \beta + \gamma) = 1,$$

that is,

$$\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma + 2 \sin \alpha \sin \beta \sin \gamma = 1. \quad (2)$$

But $\sin \alpha = a/x$; $\sin \beta = b/x$; $\sin \gamma = c/x$. Substituting these values in (2), we have

$$x^3 - x(a^2 + b^2 + c^2) - 2abc = 0. \quad (3)$$

This cubic has two negative roots and one positive root, as may be seen by putting $x = 0$, $-a$, $-\infty$. The positive root is the value of x required. We can then describe a semicircle having this root as a diameter and place in it the chords a , b , c , in any order; for the equation (3) involves a , b , c , symmetrically.

Note.—The cubic (3) can also be derived as follows:

Draw the diagonals AC and BD . Then

$$AC = \sqrt{x^2 - c^2}, \quad BD = \sqrt{x^2 - a^2}.$$

Hence, by *Ptolemy's Theorem* we have

$$\sqrt{x^2 - c^2} \cdot \sqrt{x^2 - a^2} = ac + bx,$$

whence

$$x^3 - (a^2 + b^2 + c^2)x - 2abc = 0,$$

as before.

Also solved by ELIJAH SWIFT, ELMER SCHUYLER, and A. M. HARDING.

MECHANICS.

273. Proposed by F. P. MATZ, Reading, Pa.

A person is placed on a perfectly smooth surface. How may he get off.

SOLUTION BY S. W. REAVES, University of Oklahoma.

He should throw some object, for example his hat, in the opposite direction to that in which he wishes to go. The reaction, or "recoil," will cause him to slide to the edge of the smooth surface.

284. Proposed by C. N. SCHMALL, New York, N. Y.

A cylindrical vessel standing upright on a horizontal plane is kept constantly full of water by an automatic device. Determine at what height in its side a small orifice should be made,